Percutaneous Intervention of Unprotected Left Main Disease

Technical feasibility and Clinical outcomes

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Professor of Internal Medicine
Asan Medical Center, Seoul, Korea
# Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
- Bail-out unprotected left main stenting
- Elective unprotected left main stenting
- In the era of drug-eluting stent
Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
Primary Stenting for AMI patients with Left Main Coronary Artery Occlusion

2003 AMC Data
Primary LMCA Stenting

Background

• Primary angioplasty or stenting have emerged as a valuable reperfusion strategy for management of AMI

• However, the issue of best approach to LMCA disease during AMI is controversial
## Primary LMCA Stenting

### Previous Pilot Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Balloon / Stent</th>
<th>In-hospital mortality</th>
<th>Long-term mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quigley</td>
<td>1993</td>
<td>4/0</td>
<td>100%(4/4)</td>
<td>-</td>
</tr>
<tr>
<td>Chauhan</td>
<td>1997</td>
<td>6/0</td>
<td>83% (5/6)</td>
<td>-</td>
</tr>
<tr>
<td>ULTIMA</td>
<td>2001</td>
<td>23/17</td>
<td>55%(22/40)</td>
<td>57%</td>
</tr>
<tr>
<td>Yip</td>
<td>2001</td>
<td>8/10</td>
<td>33% (6/18)</td>
<td>56% (8/18)</td>
</tr>
<tr>
<td>Neri</td>
<td>2002</td>
<td>5/17</td>
<td>50%(11/22)</td>
<td>59%(13/22)</td>
</tr>
<tr>
<td>Luca</td>
<td>2003</td>
<td>10/14</td>
<td>58%(14/24)</td>
<td>63%(15/24)</td>
</tr>
</tbody>
</table>
Primary LMCA Stenting

Predictors of Survival

• Dominant RCA
• Good intercoronary collaterals (≥ 2)
• Post TIMI 3 flow
• Cardiogenic shock (negative predictor)
### Baseline Demographics

<table>
<thead>
<tr>
<th></th>
<th>n=18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yrs</td>
<td>59±12</td>
</tr>
<tr>
<td>Men</td>
<td>16 (89%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>3 (17%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>4 (22%)</td>
</tr>
<tr>
<td>Current smoker</td>
<td>10 (56%)</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>7 (39%)</td>
</tr>
<tr>
<td>Condition</td>
<td>Count (Percentage)</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Prior MI</td>
<td>1 (6%)</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>14 (78%)</td>
</tr>
<tr>
<td>Ventilator support</td>
<td>7 (39%)</td>
</tr>
<tr>
<td>Abxicimab</td>
<td>12 (67%)</td>
</tr>
<tr>
<td>IABP support</td>
<td>14 (78%)</td>
</tr>
</tbody>
</table>
## Primary LMCA Stenting

### Angiographic Findings

<table>
<thead>
<tr>
<th>Lesion location</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ostium</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td>Body</td>
<td>7</td>
<td>38%</td>
</tr>
<tr>
<td>Bifurcation</td>
<td>10</td>
<td>56%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lesion length</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13±7</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ref vessel diameter (mm)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9±0.3</td>
<td></td>
</tr>
</tbody>
</table>
### Primary LMCA Stenting

## In Hospital Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiographic success (TIMI ≥ 2, DS &lt; 30%)</td>
<td>17 (94%)</td>
</tr>
<tr>
<td>Emergency CABG</td>
<td>2 (11%)</td>
</tr>
<tr>
<td>Elective CABG</td>
<td>2 (11%)</td>
</tr>
<tr>
<td>Other lesion stenting</td>
<td>6 (33%)</td>
</tr>
<tr>
<td>Death</td>
<td>8 (44%)</td>
</tr>
</tbody>
</table>

*n = 18*
## Primary LMCA Stenting

### Long-term Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-Up (months)</td>
<td>39±22</td>
<td></td>
</tr>
<tr>
<td>TLR(CABG)</td>
<td>1 (6%)</td>
<td></td>
</tr>
<tr>
<td>Reinfarction</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Primary LMCA Stenting

3-year Survival

![Graph showing 3-year survival probability with 56±12% chance at 3 years, and probability decreasing over time.](Image)
# Primary LMCA Stenting

## Prognostic Determinants

<table>
<thead>
<tr>
<th></th>
<th>Alive (n=10)</th>
<th>Dead (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial TIMI ≥2</td>
<td>7 (70%)</td>
<td>1 (13%)*</td>
</tr>
<tr>
<td>Dominant RCA</td>
<td>3 (30%)</td>
<td>4 (50%)</td>
</tr>
<tr>
<td>Collaterals ≥2</td>
<td>1 (10%)</td>
<td>1 (13%)</td>
</tr>
<tr>
<td>Final TIMI flow =3</td>
<td>9 (90%)</td>
<td>4 (50%)</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>6 (60%)</td>
<td>8 (100%)</td>
</tr>
</tbody>
</table>

* p<0.05
Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
  - Primary stenting of left main during AMI is technically feasible and appropriate therapeutic option
  - Good initial TIMI flow (≥2) is important predictor of survival
  - Long term clinical outcomes of patients surviving was favorable after hospital discharge
Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
- Bail-out unprotected left main stenting
Bail-out Stenting for Left Main Coronary Artery Dissection during Coronary Angioplasty;

Acute and Long-term Results

2003 AMC Data
Bail-out LMCA Stenting

Background

• Stenting is the fastest technique in repairing the LM dissection and stabilization of hemodynamics

• However, the long-term effectiveness of bail-out stenting on the LM has not been clearly defined
Diffuse LAD
Ostial lesion

LM ostial
dissection

Bail-out
Stenting
### Bail-out LMCA Stenting

**Long-term (3 year) Clinical outcome**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=10</td>
<td></td>
</tr>
<tr>
<td>Technical Success</td>
<td>100 %</td>
</tr>
<tr>
<td>Follow-Up (Months)</td>
<td>31±25</td>
</tr>
<tr>
<td>Restenosis</td>
<td>0</td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
</tr>
<tr>
<td>TLR</td>
<td>0</td>
</tr>
</tbody>
</table>
Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
- Bail-out unprotected left main stenting

Prompt recognition of LMCA dissection and bail-out stenting save the life and provide excellent acute and long-term results.
Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
- Bail-out unprotected left main stenting
- Elective unprotected left main stenting

✓ Immediate and Late outcomes ?
✓ Role of Debulking ?
✓ Role of IVUS ?
✓ Bifurcation left main intervention ?
Subject

310 Patients
(M/F=209/101, Age: 56 years)

- Elective Stenting in Patients with Normal LV function 258

- Follow-up angiogram at 6 month 178/220 (86%)

2003 AMC
Unprotected Left Main Stenting

Inclusion Criteria

- **Good Candidate for Surgery**
  (Diameter stenosis ≥ 50% involving both a LMCA and/or the ostium of LAD or LCX with Objective Ischemia)

- **Normal LV function**

2003 AMC
Procedural Success Rate: 99%

In-Hospital Clinical Courses

- Acute closure: 0
- Subacute thrombosis: 1 (0.5%)
- Death: 0
- Q-MI: 0
- Emergent CABG: 0
Unprotected Left Main Stenting

6 month Angiographic Restenosis Rate

Angiographic follow-up rate:
178/220 eligible patients (86%)

42/178 (23.1%)
Unprotected Left Main Stenting

Restenosis Rate & TLR at overall

- Restenosis: 27 (P=0.071)
- TLR: 15 (P=0.282)

- Ostium: 5 (Restenosis) 4 (TLR)
- Shaft: 28 (Restenosis) 12 (TLR)
- Bifurcation: 15 (Restenosis) 12 (TLR)
Unprotected Left Main Stenting

4 Year Clinical Follow-up

Mean Duration 42.7 ± 55.7 months

- Symptom Recurrence: 22 (10%)
- Death: 6 (2.7%)
  - 3 in cardiac,
  - 3 in non-cardiac
Unprotected Left Main Stinting
Survival Curve

Cardiac death free survival
98 ± 1 %

Total death free survival
96 ± 2 %

MACE free survival
81 ± 3 %
Subjects

- 101 consecutive patients with unprotected LM PCI
- Clinical follow up at 6-months in 96 cases
- Pre and post QCA analysis, in 61 cases
- AMI was excluded

Takahiko Suzuki, JIM 2003
# Subjects

<table>
<thead>
<tr>
<th>Total No (n)</th>
<th>101</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of lesions vessels (n)</td>
<td></td>
</tr>
<tr>
<td>0 (LMCA alone)</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>1</td>
<td>19 (19%)</td>
</tr>
<tr>
<td>2</td>
<td>34 (33%)</td>
</tr>
<tr>
<td>3</td>
<td>41 (41%)</td>
</tr>
<tr>
<td>Lesion location (n)</td>
<td></td>
</tr>
<tr>
<td>Ostium</td>
<td>19 (19%)</td>
</tr>
<tr>
<td>Body</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>Bifurcation</td>
<td>74 (73%)</td>
</tr>
<tr>
<td>Calcification (n)</td>
<td>53 (53%)</td>
</tr>
<tr>
<td>Diffuse (&gt;20mm) (n)</td>
<td>19 (19%)</td>
</tr>
</tbody>
</table>
## In-Hospital Outcome

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No (n)</td>
<td>101</td>
</tr>
<tr>
<td>Clinical success</td>
<td>99 (99%)</td>
</tr>
<tr>
<td>Cardiac death (n)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Non-cardiac death (n)</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Q MI</td>
<td>0</td>
</tr>
<tr>
<td>Urgent CABG</td>
<td>1 (1%)</td>
</tr>
</tbody>
</table>

*Takahiko Suzuki, JIM 2003*
<table>
<thead>
<tr>
<th>Event</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No (n)</td>
<td>61</td>
</tr>
<tr>
<td>Cardiac death (n)</td>
<td>1 (1.6%)</td>
</tr>
<tr>
<td>Non-cardiac death (n)</td>
<td>2 (3.3%)</td>
</tr>
<tr>
<td>MI</td>
<td>0</td>
</tr>
<tr>
<td>CABG</td>
<td>1 (1.6%)</td>
</tr>
<tr>
<td>Re-PCI</td>
<td>20 (32.8%)</td>
</tr>
<tr>
<td>TLR</td>
<td>10 (16.4%)</td>
</tr>
</tbody>
</table>

*Takahiko Suzuki, JIM 2003*
Longterm Outcomes of Unprotected Left Main Stenting in Selected Patients with Normal LV Function

-Multicenter Registry Data-
Japan and Korea
(N=280)

2003 Am J Cardiol
Multicenter Registry Data

Procedural Success Rate: 98.2%

In-Hospital Clinical Courses

- Acute closure: 0
- Subacute thrombosis: 3 (1.1%)
- Death: 0
- Q-MI: 3 (1.1%)
- Emergent CABG: 3 (1.1%)
6 month Angiographic Restenosis Rate

Angiographic follow-up rate:
247 / 280 eligible patients (88.2%)

51 / 247 (20.6%)
3 Year Clinical Follow-up

- Symptom Recurrence: 32 (11.4%)
- Death: 22 (7.9%)

9 cardiac, 12 non-cardiac
Survival Curve

Multicenter Registry Data

Cardiac death-free survival: 96.5 ± 1.1%
All death-free survival: 92.0 ± 1.8%
MACE-free survival: 77.8 ± 2.6%

Cumulative percentage vs. Duration of follow-up (months)
<table>
<thead>
<tr>
<th></th>
<th>Univariate</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
<td></td>
<td>P</td>
</tr>
<tr>
<td>Age</td>
<td>1.03</td>
<td>1.01~1.05</td>
<td>0.008</td>
<td></td>
</tr>
<tr>
<td>Reference size</td>
<td>0.45</td>
<td>0.29~0.69</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Combined CAD</td>
<td>1.84</td>
<td>1.11~3.06</td>
<td>0.017</td>
<td></td>
</tr>
<tr>
<td>Post-MLD</td>
<td>0.48</td>
<td>0.33~0.69</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multivariate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined CAD</td>
<td>0.50</td>
<td>0.34~0.72</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Post-MLD</td>
<td>1.82</td>
<td>1.08~3.05</td>
<td>0.024</td>
<td></td>
</tr>
</tbody>
</table>
Immediate Outcomes?

Unprotected left main stenting in selected patients with normal LV function.

- Technical success rate was 98-99%
- No procedure related mortality
- SAT rate was 0.5 - 1.0%

It is Safe!
Late Outcomes?

Unprotected left main stenting in selected patients with normal LV function.

- Restenosis rate was 20-25%, TLR 12-16%
- All death free survival was 92-96%, MACE free survival was 78-82% during 4 year clinical follow-up period

Good Long-term Outcome!
Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
- Bail-out unprotected left main stenting
- Elective unprotected left main stenting

✔ Immediate and Late outcomes?
✔ Role of Debulking?
Unprotected Left Main Stenting
Reduction of Plaque Burden

- DCA: 30%
- Flexi Cut: 41%
<table>
<thead>
<tr>
<th></th>
<th>DCA + stent</th>
<th>Stent alone</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference vessel DM (mm)</strong></td>
<td>4.12 ± 0.62</td>
<td>3.92 ± 0.67</td>
<td>0.029</td>
</tr>
<tr>
<td><strong>MLD (mm)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-intervention</td>
<td>1.16 ± 0.45</td>
<td>1.23 ± 0.565</td>
<td>0.338</td>
</tr>
<tr>
<td>Post-intervention</td>
<td>4.23 ± 0.57</td>
<td>4.05 ± 0.57</td>
<td>0.022</td>
</tr>
<tr>
<td>Follow-up</td>
<td>2.95 ± 0.91</td>
<td>2.65 ± 1.13</td>
<td>0.076</td>
</tr>
<tr>
<td><strong>Pressure (atm)</strong></td>
<td>14.8 ± 2.94</td>
<td>14.8 ± 2.74</td>
<td>0.343</td>
</tr>
<tr>
<td><strong>Angiographic follow-up (%)</strong></td>
<td>89</td>
<td>81</td>
<td>0.781</td>
</tr>
<tr>
<td><strong>Restenosis rate (%)</strong></td>
<td>16.4</td>
<td>29.4</td>
<td>0.071</td>
</tr>
</tbody>
</table>
Unprotected Left Main Stenting

Restenosis Rate & TLR

at Ostial lesion

- Debulking:
  - Restenosis: 6%
  - TLR: 0%
  - P=0.025

- Non-Debulking:
  - Restenosis: 33%
  - TLR: 19%
  - P=0.026
Restenosis Rate
according to reference vessel size

<table>
<thead>
<tr>
<th>Ostial lesion (mm)</th>
<th>Debulking+stent</th>
<th>Stenting alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3.5</td>
<td>0/5</td>
<td>0/3</td>
</tr>
<tr>
<td>&gt;3.5, ≤3.8</td>
<td>12/20</td>
<td>3/10</td>
</tr>
<tr>
<td>&gt;3.8, ≤4.0</td>
<td>0/3</td>
<td>0/3</td>
</tr>
<tr>
<td>&gt;4.0</td>
<td>1/5</td>
<td>4/25</td>
</tr>
</tbody>
</table>

P = 0.016
Effect of Debulking ...

at Left Main Bifurcation

Restenosis P=0.176
TLR P=0.553

Debulking:
- Restenosis: 21%
- TLR: 14%

Non-Debulking:
- Restenosis: 37%
- TLR: 10%
Effect of Debulking In Negative Vascular Remodeling

Debulking (n=17)
Non-debulking (n=25)

Stent CSA (mm²)

13.8
12.3

P=0.103

Restenosis rate (%)

23 %
24 %

P=1.000
Effect of Debulking
In Non-negative Vascular Remodeling

P = 0.098

Stent CSA (mm²)

Debulking (n=24)
13.4

Non-debulking (n=20)
12.0

P = 0.012

Restenosis rate (%)

Debulking (n=24)
8%

Non-debulking (n=20)
45%
DCA alone vs. DCA+ Stent

TLR

P=0.03

Overall: 14.6%
DCA alone: 33.3%
DCA+Stent: 4.9%

Takahiko Suzuki, JIM 2003
Stent vs. DCA+ Stent

TLR

Overall: 7.0%
Stent alone: 7.1%
DCA+Stent: 6.9%

\( P = \text{NS} \)

Takahiko Suzuki, JIM 2003
DCA alone vs. DCA+ Stent

TLR

Bifurcation Lesion

Overall DCA alone DCA+Stent

14.3% 33.3% 4.3%

p=0.0010

Takahiko Suzuki, JIM 2003
Stent vs. DCA+ Stent

TLR  Bifurcation Lesion

Overall  Stent alone  DCA+Stent

5.9%  14.3%  3.7%

P=NS

Takahiko Suzuki, JIM 2003
Unprotected Left Main Stenting

- Elective unprotected left main stenting
  - Immediate and late clinical outcomes
  - Role of Debulking?
Restenosis Rate according to reference vessel size

Overall

**(%)**

P=0.07

- Debulking+stent
- Stenting alone

<table>
<thead>
<tr>
<th>Reference Vessel Size</th>
<th>Debulking+stent</th>
<th>Stenting alone</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5-3.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;3.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;4.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Restenosis Rate according to reference vessel size

\( P = 0.016 \)

- **Debulking+stent**
  - \(<3.5\): 0/5
  - \(>3.5 \leq 3.8\): 0/3
  - \(>3.8 \leq 4.0\): 0/3
  - \(>4.0\): 1/6
- **Stenting alone**
  - \(<3.5\): 12/20
  - \(>3.8\): 3/10
  - \(>4.0\): 4/25

Cardiovascular Research Foundation

ANGIOPLASTY SUMMIT
DCA seems to be beneficial in small reference vessel with non-negative remodeling lesions.
Unprotected Left Main Stenting

- Elective unprotected left main stenting
  ✓ Immediate and late clinical outcomes
  ✓ Role of Debulking?

How much plaque burden should be removed?
Unprotected Left Main Stenting

Only Predictor of Restenosis
-Multivariate Analysis-

- Reference vessel size
  Ref. MLD by QCA and IVUS
  OR=0.39, 95% CI (1.17-0.87) P=0.021

  Ref. CSA by IVUS
  OR=0.65, 95% CI (0.44-0.97) P=0.033
Conclusion

• In PCI for ULM bifurcation lesion, larger lumen size can be expected to bring better chronic outcome.

• In order to achieve that, combination of DCA and stenting is an effective strategy.

Takahiko Suzuki, JIM 2003
Post - LA vs. TLR

TLR

<table>
<thead>
<tr>
<th>Group</th>
<th>(%</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>16.4</td>
<td>(10/61)</td>
</tr>
<tr>
<td>LA&lt;8</td>
<td>56.2</td>
<td>(5/9)</td>
</tr>
<tr>
<td>8&lt;LA&lt;10</td>
<td>30.8</td>
<td>(4/13)</td>
</tr>
<tr>
<td>10&lt;LA&lt;12</td>
<td>11.1</td>
<td>(1/9)</td>
</tr>
<tr>
<td>12&lt;LA&lt;14</td>
<td>5.3</td>
<td>(1/19)</td>
</tr>
<tr>
<td>14&lt;LA</td>
<td>0</td>
<td>(0/11)</td>
</tr>
</tbody>
</table>

p=0.0057

Takahiko Suzuki, JIM 2003
Post - % PA vs. TLR

TLR

Overall (10/61) %PA<50 (2/27) 50<=%PA<60 (3/20) %PA<60 (5/14)

16.4 7.4 15.0 35.7

p=NS

Takahiko Suzuki, JIM 2003
Restenosis Rate

According to Stent Lumen CSA

<table>
<thead>
<tr>
<th>Post-stent lumen CSA, mm²</th>
<th>Restenosis Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7.0</td>
<td>50%</td>
</tr>
<tr>
<td>7.0 ≤ &lt;9.0</td>
<td>33%</td>
</tr>
<tr>
<td>9.0 ≤ &lt;11.0</td>
<td>33%</td>
</tr>
<tr>
<td>&gt; 11.0</td>
<td>8%</td>
</tr>
</tbody>
</table>
How much plaque burden should be removed?

- Residual Plaque burden < 50%
- Post-stent CSA >11 mm²
Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
- Bail-out unprotected left main stenting
- Elective unprotected left main stenting

✓ Immediate and Late outcomes ?
✓ Role of Debulking ?
✓ Role of IVUS ?
## Angiographic Findings and Clinical Results

<table>
<thead>
<tr>
<th></th>
<th>IVUS-guided</th>
<th>Angio-guided</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of lesions</strong></td>
<td>133</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td><strong>Lesion site</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Os</td>
<td>72 (54)</td>
<td>35 (42)</td>
<td>0.002</td>
</tr>
<tr>
<td>Body</td>
<td>24 (18)</td>
<td>4 (5)</td>
<td>0.005</td>
</tr>
<tr>
<td>Bifurcation</td>
<td>37 (28)</td>
<td>44 (53)</td>
<td></td>
</tr>
<tr>
<td><strong>Debulking before stenting</strong></td>
<td>54 (41)</td>
<td>17 (21)</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Reference vessel DM (mm)</strong></td>
<td>4.1 ± 0.7</td>
<td>3.8 ± 0.6</td>
<td>0.005</td>
</tr>
<tr>
<td><strong>MLD (mm)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-intervention</td>
<td>1.3 ± 0.5</td>
<td>1.1 ± 0.5</td>
<td>0.011</td>
</tr>
<tr>
<td>Post-intervention</td>
<td>4.2 ± 0.6</td>
<td>4.0 ± 0.6</td>
<td>0.002</td>
</tr>
<tr>
<td>Follow-up</td>
<td>2.8 ± 1.1</td>
<td>2.6 ± 1.1</td>
<td>0.160</td>
</tr>
<tr>
<td><strong>Restenosis Rate (%)</strong></td>
<td>24/105 (23)</td>
<td>12/52 (23)</td>
<td>0.980</td>
</tr>
</tbody>
</table>
IVUS findings of Left Main Disease

- Soft plaque: 63%
- Fibrous Calcific: 18%
  (Mean calcification: 147°)
- Eccentricity index: 6.5 ± 6.2
- Negative Remodeling in Ostial Lesions: 47/72 (65%)
  (Mean NRI: 0.91 ± 0.25)
Unprotected Left Main Stenting

IVUS-guiding is Necessary

- Clinical outcomes may be not different
- Assess unusual lesion morphology (severe negative remodeling, calcium, thrombi, etc)
- We can change treatment strategy
- Optimized final results
Unprotected Left Main Stenting

- Primary stenting in the setting of AMI
- Bail-out unprotected left main stenting
- Elective unprotected left main stenting

- Immediate and Late outcomes ?
- Role of Debulking ?
- Role of IVUS ?
- Bifurcation left main intervention ?
PCI Strategy for LM Bifurcation lesion

1. Stenting cross over LCX with optional kissing balloon inflation
2. T-stent technique
3. Kissing stent technique
4. Bifurcation stent (SLK-View stent)
Stenting Cross Over

Tube stenting cross over LCX with optional kissing balloon dilatation

LMCA

LCX

LAD
T Stenting

LMCA

LCX

LAD
T Stenting

LMCA

LCX

LAD
Y (Culotte) Stenting

LMCA

LCX

LAD
Y (Culotte) Stenting

LMCA

LCX

LAD
Kissing Stenting

Kissing stents with optional stent on the Main

LMCA

LCX

LAD
Bifurcation Stent

SLK-View Stent

Side hole
82 patients
(M / F=70/12, Age 59 yrs)

Strategies

40 Stent Alone
42 DCA + Stent
## Unprotected Left Main Bifurcation Stenting

<table>
<thead>
<tr>
<th>Metric</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural Success Rate:</td>
<td>100 %</td>
</tr>
<tr>
<td>In-Hospital Clinical Complications</td>
<td>0 %</td>
</tr>
<tr>
<td>Restenosis Rate</td>
<td>23 %</td>
</tr>
<tr>
<td>TLR, 3 year F/U</td>
<td>10 %</td>
</tr>
</tbody>
</table>
Selection

Different Technique

<table>
<thead>
<tr>
<th>Technique</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stenting cross over</td>
<td>50</td>
<td>61%</td>
</tr>
<tr>
<td>T-Stent</td>
<td>13</td>
<td>16%</td>
</tr>
<tr>
<td>Kissing stent</td>
<td>7</td>
<td>8%</td>
</tr>
<tr>
<td>SLK-View stent</td>
<td>11</td>
<td>13%</td>
</tr>
<tr>
<td>Debunking only</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
6 month Angiographic Restenosis

According to different strategy

- Stenting cross over: 10/42 (24%)
- T(Y)-Stent: 5/11 (46%)
- Kissing stent: 4/7 (57%)
- SLK-View stent: ?/11
Effect of Debulking …

at Left Main Bifurcation

- Restenosis: 26% (Debulking), 38% (Non-Debulking)
- TLR: 23% (Debulking), 24% (Non-Debulking)

P-values:
- Restenosis: P=0.313
- TLR: P=0.947
Angiographic Restenosis Rate depending on the different technique

- **Stenting cross over**: 5/15 (33%) Debulking, 0/3 Non Debulking
- **T-Stent**: 2/6 (33%) Debulking, 0/1 Non Debulking
- **Kissing stent**: 1/5 (20%) Debulking, 1/4 Non Debulking
- **SLK-View stent**: 2/19 (11%) Debulking, 1/5 Non Debulking
- **DCA only**: 25% Debulking, 0/1 Non Debulking

Cardiovascular Research Foundation

ANGIOPLASTY SUMMIT
Angiographic Restenosis Rate depending on number of stents

- **Debulking**
  - Single stent: 6/20 (30%) with p = 0.369
  - Multiple stent: 4/9 (44%) with p = 0.637

- **Non Debulking**
  - Single stent: 4/22 (18%)
  - Multiple stent: 5/9 (56%)
3-Year Survival
According to Lesion Location (AMC data)

Log rank $P = 0.72$

Duration of Follow-Up (year)

Cumulative Survival (%)

- Ostium: $97.6 \pm 1.7\%$
- Shaft: $94.7 \pm 5.1\%$
- Bifurcation: $93.7 \pm 3.5\%$
3-Year MACE-Free Survival

According to Lesion Location (AMC)

Log rank $P = 0.37$

Duration of Follow-Up (year)

Cumulative Survival (%)

- Ostium: $84.7 \pm 3.6\%$
- Shaft: $83.0 \pm 7.9\%$
- Bifurcation: $73.1 \pm 5.9\%$
3-Year TLR-Free Survival

According to Lesion Location (Multicenter)

Log rank $P = 0.56$

$N = 280$

- **Ostium**: $88.2 \pm 3.4\%$
- **Shaft**: $81.5 \pm 7.0\%$
- **Bifurcation**: $79.4 \pm 4.8\%$

Duration of Follow-Up (month)
Unprotected left main Bifurcation stenting
Technical feasibility, safety and outcomes

- Stenting cross over LCX would be the most effective technique
- Debunking seemed to be beneficial
- Could be an alternative to surgery in highly selected patients, but requires meticulous bifurcation technique
Intervention 2003
Era of Drug Eluting Stent

Running to the New Heights…
Unprotected LM stenting
Era of Drug Eluting Stent

We need more data…
Intervention 2003
Era of Drug Eluting Stent

Left main trifurcation lesion, treated by 3 Cyphers...

Operator: A. Colombo, SJ Park from JIM 2003
Case presentation is shown in http://summitmd.com.
Stent - Crush

LMCA

LCX

LAD
Stent - Crush

Crushed first stent implanted in side branch

LMCA

LCX

LAD
The procedure of unprotected left main stenting would be very simplified as Just stent it!